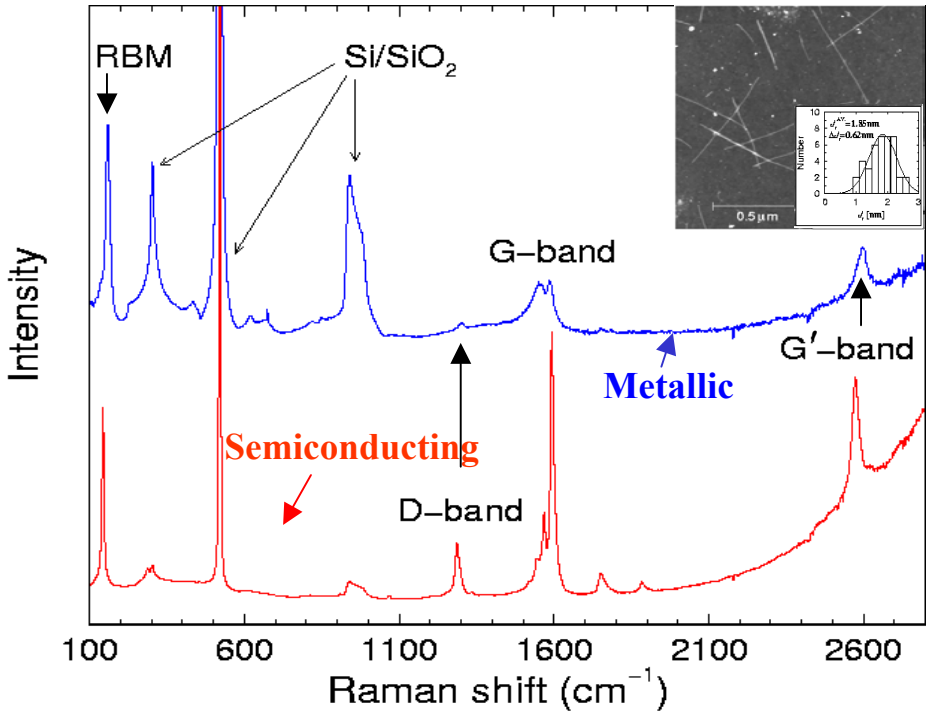
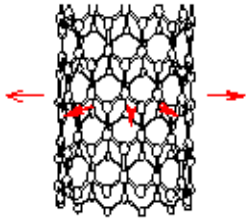
(Raman Scattering from Carbon Nanotubes) I
Mildred S. Dresselhaus, MIT DMR-01-16042

Because of the molecular nature of a single carbon nanotube approximately one nanometer in diameter, the density of electronic states is very large at certain discrete energies. This allows observation of the vibrational frequencies of individual nanotubes under resonance conditions, as shown in the figure for isolated nanotubes sitting on a silicon substrate. The vibrations labeled RBM can be used to distinguish the structure (diameter and chirality) of the nanotubes while the vibrations labeled G-band distinguish nanotubes as metallic or semiconducting in accordance with their Raman lineshapes. The features labeled D-band and G´-band are dispersive and provide information about non-zone-center phonons and also about the electronic structure, through the strong coupling between electrons and phonons under resonance conditions. Studies at the single nanotube level provide new insights into conventional Raman spectra that are used to characterize ensembles of nanotubes.

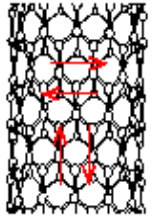
Single Nanotube Raman Spectroscopy



RBM



G-band



(Raman Scattering from Carbon Nanotubes) II
Mildred S. Dresselhaus, MIT DMR-01-16042

Educational:

Undergrads: Victor Brar

Grad students: Georgii G. Samsonidze, S. Grace Chou, Antonio G. Souza Filho

Post-Docs: Ado Jorio

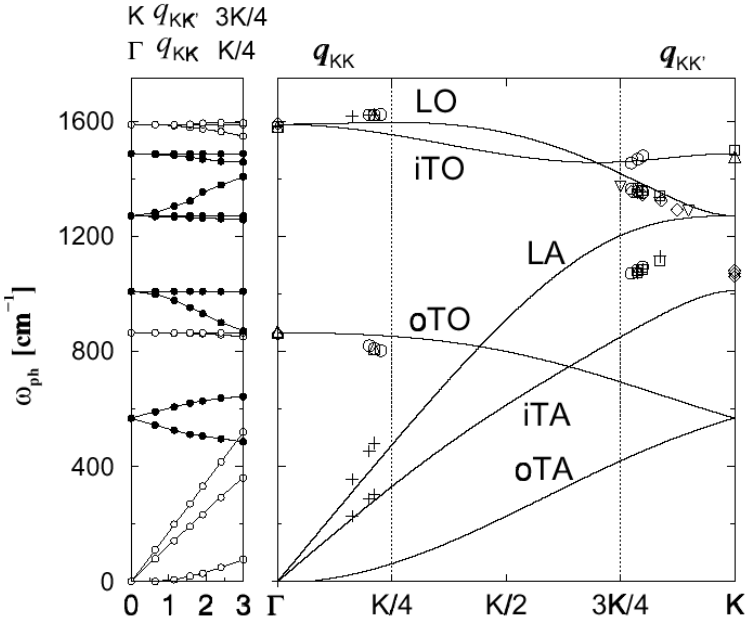
Outreach Activities:

- Invited talk for Workshop on Survival Skills at American Physics Society March Meeting sponsored by the Committee on the Status of Women in Physics (CSWP/APS)
- Chaired Review at Argonne National Laboratory on the Status of Women in Physics sponsored by CSWP/APS

Honors and Awards:

- Medal for achievement in Carbon Science and Technology by the American Carbon Society, July 2001
- Ford Lecture, University of Michigan, October, 2001
- Bayer Lecture, University of Pittsburgh, October, 2001
- Soo Lecture, University of Illinois, Urbana, November, 2001

Probing the interior of the phonon Brillouin zone in graphite by double resonance Raman spectra



Single nanotube spectroscopy is not only sensitive to zone center modes, but non-zone-center modes can also be observed through a double resonance process, thereby providing a characterization technique for phonon dispersion relations on the nano-scale, where conventional neutron scattering approaches cannot be used because of the tiny sample size. The above diagram shows our successful use of resonance Raman scattering to map out the corresponding dispersion curves for graphite.